INFLUENCE OF NUTRITION ON SEX AMONG THE LEPIDOPTERA.

BY THOMAS G. GENTRY.

That the sexes among plants are controlled by the *law of nutrition*, I think has been demonstrated by Mr. Thomas Meehan, in his communications to the Academy of Natural Sciences, published in its proceedings, in the *American Naturalist*, and in other scientific journals. The facts which appear in his contributions upon this subject were the results of close research and careful study. To him must be ascribed, not only the credit of having established the existence of the afore-mentioned law, but also the hint of its potency in animals.

Mrs. Mary Treat, I believe, is entitled to the credit of first showing its applicability in insects, in a paper which appeared in the *American Naturalist* for March, 1873. The facts set forth in her paper were founded on observations upon the larvæ of some species of Diurnal Lepidoptera during the summer of 1872. The inferences which she drew from her observations were substantially as follows: Whenever the larvæ were deprived of food, or were stinted in quantity, in the interval between the last two changes, males were produced in the generality of cases; but when the food was regularly supplied, and in bulk necessary for the wants of the larvæ, the opposite sex was almost invariably produced.

The facts which I have to offer bearing upon the genesis of sexes, date back to the summer of 1871, whilst engaged in the rearing of the larvæ of many of our Twilight and Night Fliers, and in the study of their various metamorphoses. The discovery was the result of accident: I had confined a number of the larvæ of *Attacus cecropia*, *A. polyphemus*, *A. prometheus*, and *Saturnia Io*, in a box, and had neglected to supply them with food for four days. These larvæ had advanced toward their final change, possibly within a week or ten days. When I opened the box, the greater number, which fell not much short of a score and a half, had concealed themselves within cocoons; the remainder still wandered about, as if in quest of food, or seeking for some opening through which to escape. These latter I removed from the box to another, where they were provided with an abundance of food. They immediately recommenced feeding. After three or

four days they began to assume the chrysalis form. After several weeks I removed the usual silken covering, as has always been my custom, from the fact that past experience has shown me that the development proceeds more rapidly, especially when they are kept in a room where the temperature through the cold season of the year falls not short of 70° Fah. I was surprised to find that those which had changed first turned out to be males without exception, while the last batch, consisting of a dozen cocoons, proved with but two exceptions to be females. Here was a problem to solve, and in reflecting upon the subject it occurred to me that possibly Mr. Meehan's *law of nutrition* would furnish me with an explanation of it. I conducted a series of experiments during the ensuing summer, to test the truth of my observations. Accordingly in August and September I procured besides specimens of the larvæ above mentioned, many of the *Ceratocampa regalis*, *Dryocampa imperialis*, *Sphinx quinquemaculata*, *S. carolina*, *Smerinthus excæcata*, and others of the Sphinx family. These worms were taken while passing through the period intervening between the last and the preceding changes. In nearly every case the worms were selected as shortly after the next to the last change as was possible. These worms, amounting to three scores, were divided into two equal sets and placed in separate boxes. The one set was deprived of all food; the other was kept provided with fresh, wholesome fare in abundance. The members of the first set, after the expiration of a few days, began to appear exceedingly restless, as if looking for some convenient place to hang their cocoons, or to deposit their chrysalides. Those of the second kept on feeding for a week or ten days, and then began to undergo their final transformation. The difference in the appearance of the two sets was quite perceptible. The former were small, and presented the look of animals that had been ill-fed; the latter were large and plump, and showed evidence of having fed sumptuously. After allowing sufficient time to elapse for the chrysalides to form and harden, I began the work of divesting them of their cocoons. I found that the chrysalides of the one, as the greater breadth of the antennæ, which was already mapped out, would seem to indicate, were invariably males, while the other, judging from the narrowness of the antennæ, proved with but two exceptions to be the opposite sex. The chrysalides of the Sphinxes presented a similar state of affairs. The appearance of the perfected

moths proved that the sexes had been distinctly indicated by the difference in the breadth of the antennæ as observed in the chrysalides.

During my observations and experiments the following additional facts came under my notice: Firstly, that males are the invariable result when the larvæ are fed upon diseased or innutritious food; secondly, that in the fall of the year, when the leaves have become deprived of their usual amount of sap, males are generally produced; thirdly, that more males are produced late in the season than females; fourthly, that the sexes in early life cannot be distinguished, or in other words, that there would appear to be no such distinction as male and female, the change being brought about late in life through the medium of nutrition.